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**Comments on Shemie et al.:
International guideline
development
for the determination of death**

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Dear Editor,
We read with interest the article by Shemie et al. [1] in the June 2014 issue of *Intensive Care Medicine*. We commend the authors on working toward a consensus on the definition of death, which is critical in ensuring ethical organ transplantation [1] and avoiding futile use of healthcare resources.

In our opinion, many patients for whom a rapid determination of death is required are in such a serious clinical state that the healthcare providers do not entertain the possibility of brain death. Such patients are often seen in the severe trauma setting, where vast healthcare resources are expended before any evaluation of the survival chance of the patient is considered.

Therefore, there is an urgent need for a valid test that can indicate the chances of survival of a patient at the time of presentation. This test should use the appropriate technology and focus on assessing the key brain functions that are necessary for life. As the forum participants agreed [1], it is the cessation of function in the brainstem, not necessarily that of the whole brain, that constitutes the operational definition of death.

Consequently, imaging of the brainstem is vital for determining when death has occurred.

Most of the ancillary imaging tests focus on the global cessation of brain activity. We want to highlight what has been learnt from the imaging of acute stroke. Computed tomographic angiography (CTA) or digital subtraction angiography (DSA) in cases of acute stroke, even in cases of large territorial infarct, can show continued filling of the arteries and veins in that part of the brain. Larger vessels can continue to fill even with non-functioning capillaries due to the presence of collaterals. Thus, non-opacification of arteries and veins (as assessed by CTA or DSA) in the event of brain death is a very late phenomenon.

Both CTA and DSA are accepted ancillary tests for confirmation of brain death [2–4]. However, even when there are slowly filling or delayed collaterals in cases of established infarct, the perfusion study will show a matched decrease in cerebral blood flow and cerebral blood volume in the region of interest. To determine brain death and, more appropriately, brainstem death, we need to shift focus from the larger vessel perfusion to capillary perfusion.

Unfortunately, neither DSA or CTA show evidence of capillary perfusion with any confidence. Thus, neither technique provides sufficient information on brainstem function. In a recent paper, Shankar and Vandrope [5] described the use of computed tomography perfusion (CTP) for confirmation of brain death, with a focus on brainstem function. These authors proposed that complete cessation of brainstem perfusion is possible despite preservation of perfusion in the remaining brain parenchyma. In their article, this divergence between function of

the brain and function of the brainstem is shown elegantly in the images of two patients.

We would like to draw attention to the technique of CTP, which is widely available and can be performed in settings of acute trauma. The timely determination of brain death by incorporating CTP in acute trauma settings to image the brainstem can facilitate organ transplantation and save vast healthcare resources.

Conflicts of interest None.

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